

IV Costs Analysis

These appraisal level cost estimates have been developed as a means of comparing the various options of providing a future water supply to the Red Rive Valley study area. Some options will have higher annual operation, maintenance, and pumping costs. To compare the alternatives on an equal basis, a total cost analysis approach was used. The total cost analysis included capital costs for construction and the present worth value of the annualized costs. Present worth factors for the annualized costs were computed assuming a federal discount interest rate of 6-7/8 % and a 50 year design life.

Cost Estimates

Quantity estimates for identified major construction items were calculated and placed on estimate worksheets. Estimators used standard industry books and methods for determining appraisal level construction cost estimates. Since the confidence in fully identifying all items that may be needed for construction is low at the appraisal level, an additional 20% was added to the net items cost for determining an approximate field cost. This would cover unlisted items that would be smaller in nature. Contingencies were estimated at 25% which was added to determine an approximate field cost. The overall cost with the necessary design investigations, engineering, environmental mitigation, and construction management added an additional 33% for non-reservoir features and 36% for features involving reservoirs. Some obvious differences exist between features when considering the impact or mitigation that may be required. The total cost estimate included all of the above percentage additions.

Construction Costs

The following standards were used or assumptions were made:

- ? Pipe costs includes furnishing and installing pipe, all associated earthwork, and Right-of-Way costs.
- ? Furnishing and installing pipe costs were based on costs found in Means and from previous BOR jobs.
- ? Earthwork costs were based on 6-foot average cover depth with 1.5:1 side-slopes for 24-inch diameter and larger pipe; smaller diameter pipe was assumed to be constructed with the same cover, but using a 6-foot wide trench box.
- ? Bedding, compaction, and minimum trench widths were based on BOR standards.
- ? Width for ROW was assumed to be triple the trench width plus 50 feet.
- ? Costs for blowoff and air valve installations were based on typical BOR installations.
- ? Pipe-jacking costs were based on costs taken from Means.
- ? Telemetry costs were based on length of pipe plus an allowance for other equipment.
- ? Cathodic protection was assumed to be \$5/foot for steel pipe and nothing for PVC pipe.

- ? Costs for tanks were taken from Means (adjusted for different heights and volumes).
- ? Costs for air chambers were based on BOR jobs with similar requirements. (Some interpolation and extrapolation was required.)
- ? Pumping plant costs were taken from the BOR's PUMPLT program and adjusted for variable or fixed speed conditions and for forebay conditions (canal, river, reservoir, in-line, etc.)

OPERATION, MAINTENANCE AND REPLACEMENT COSTS

This appendix provides for annual OM&R costs. Each feature will have a associated minimum OM&R cost per Reclamation's unpublished "Estimated Annual OM&R Associated With The Used And Unused Capacity of Existing Garrison Diversion Unit Principal Supply Works Features Draft Report," March, 1999. This minimum OM&R cost is that which must be covered annually no matter which feature or alternative is used including a no-action scenario. The costs are as follows:

Summary of Principal Supply Works Estimated Annual OM&R Costs

Existing features / Items with used and unused capacity	Annual OM&R Costs
a. Snake Creek Pumping Plant (including energy and power transmission)	\$233,000
b. McClusky Canal (through mile 62)	\$1,053,000
c. New Rockford Canal	\$350,000
d. McClusky Canal Abandoned Reaches (mile 62 - 74)	\$50,000 ¹
e. Fish and Wildlife Mitigation, McClusky and New Rockford Canals	\$223,000
f. Fish and Wildlife Mitigation, Lake Audubon	\$230,000
TOTAL	\$2,139,000

¹ This cost may be removed from features which utilize this portion of the canal. For those features which utilize this portion of McClusky Canal (mile 62 - 74), an annual cost of \$203,808 must be added to the total.

There are additional OM&R costs associated with those features that utilize all or parts of the existing Garrison supply facilities. These items have been estimated by the Dakotas Area Office and include items such as :

Intake Channel for Snake Creek Pumping Plant	\$5.1 million
McClusky Canal repairs	\$36.9 million
New Rockford Canal lining and repairs	\$8.9 million
New Rockford Canal overflow outlet	\$7.0 million
(This is needed for an emergency wasteway)	

Additional new items that may apply to the overall annual OM&R costs are as follows
Winter Operation For MR&I Releases
(McClusky & New Rockford Canals) \$52,000

There are a multitude of features and alternatives within this report that do not utilize New Rockford Canal and/or portions of McClusky Canal to supply water to the Red River Valley. There has been much discussion on what is the best way to deal with this.

For the purposes of this report, Reclamation lumped the ideas into three basic categories for dealing with the canals.

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| 1) Minimum Maintenance: | Perform those tasks which would be required to maintain the structural stability of the canals and to maintain cross-drainages for the purposes of safety and to minimize damages that could occur to adjacent land owners. |
| 2) Partial Abandonment: | Reclaim portions of the canals to their original state to allow for natural cross-drainage of surface waters. Transfer title of the canals to either the adjacent land owners or a state agency. |
| 3) Full Abandonment: | Fully reclaim the canals to their original state. Title would be transferred to adjacent land owners or state agency. |

All three categories hold liability issues for the federal government. Minimum maintenance and partial abandonment hold the government at a high level of liability due to the safety and flooding issues associated with the remaining facilities. Full abandonment removes a substantial portion of the liability due to the near complete reclaiming of the facilities to their original state. Further study will be required to determine the cost effectiveness of partial abandonment in comparison to the liabilities associated with such work.

Because of its complexity, requirement of extensive data gathering and liability issues, the second category (partial abandonment), will not be studied further in this report other than to state that it may be required at a more in-depth level such as a Feasibility Study.

The remaining categories have been studied in greater detail and their costs are shown in the following table:

Feature	Minimum Maintenance Capitalized Cost	Minimum Maintenance Annualized Cost	Full Abandonment Capitalized Cost	Full Abandonment Annualized Cost
New Rockford Canal Reaches 1A, 1B, 2	\$5,266,000	\$350,000	\$35,326,000	\$2,348,000
McClusky Canal --mile 62 to the end Reaches 4A, 4B, 4C	\$752,000	\$50,000	\$21,148,000	\$1,406,000
McClusky Canal ^{1/} --mile 42 to the end Reaches 3A, 3B, 3C, 4A, 4B, 4C	\$6,034,000	\$401,000	\$124,791,000	\$8,294,000

^{1/} This is the portion of the McClusky Canal that would not be required for other purposes if the GDU Facilities would not be used to transport water to the Red River Valley.

The table above are based on “Abandonment of Existing Water Delivery Facilities, June 1998” as prepared for the Garrison Conservancy District by Houston Engineering, Inc., and the unpublished “Estimated Annual OM&R Associated With The Used And Unused Capacity of Existing Garrison Diversion Unit, March 1999,” as prepared by Reclamation. An interest rate of 6 percent was used with a life of 40 years.

A comparison of costs shows the minimum maintenance to be the least costly. This report will use the costs associated with minimum maintenance for the purpose comparing of alternatives.

Pumping plant OM&R costs were determined using the BOR computer program PMPOM. This program was developed by Neil J. Gillis in 1977. Pumping plants over 40 cfs were assumed to be fully attended, pumping plants 20 cfs to 40 cfs were assumed to be semi-attended, and pumping plants less than 20 cfs were assumed to be unattended. Plants were assumed to operate at full capacity 52 weeks per year and 22 hours per day.

- ? Replacement costs for pipelines were determined by assuming that 1% of the pipeline would be replaced over the life of the project. This was then converted to an annual cost. (Factor = .000713)
- ? Cathodic protection was assumed to be replaced every 20 years annualized over 50 years. (Factor = .0935)
- ? Half of the telemetry costs were to be replaced every 10 years annualized over the project life. (Factor = .0708)
- ? Overhead powerlines were assumed to have a 45 year life. (Factor = .0724)
- ? Wellfield control and monitoring equipment was assumed to have the same replacement costs as the telemetry equipment. (Factor = .0708)
- ? Well pumps were assumed to be replaced every 15 years. (Factor = .1089)
- ? Operation and maintenance costs for Kindred Dam was based on typical costs for BOR dams in North Dakota. Operation and maintenance cost for the Lake

- ? Ashtabula raise were considered to be less since the dam already exists.
Riprap and bedding material was to be replaced at 5% over the life of the project.
(Factor = .00357)
- ? Fencing was assumed to be replaced at 10% over the life of the project. (Factor = .00713)

[1] United States Department of Interior, Bureau of Reclamation, Design Standards No. 3, Water Conveyance Systems, Chapter 11, "General Hydraulic Considerations," draft 1992

[2] United States Department of Interior, Bureau of Reclamation, "Pumps and Drivers," 1975